Smectite-Illite Transition in Barbados Accretionary Wedge Sediments: TEM and AEM Evidence for Dissolution/Crystallization at Low Temperature

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Abstract: Sediments from depths to 670 m in the Barbados accretionary complex and transecting the décollement zone have been studied by transmission and analytical electron microscopy (TEM/AEM). The sediments consist of claystone and mudstone intercalated with layers of volcanic ash. Smectite comprises the bulk of the noncalcareous sediments and forms a continuous matrix enveloping sparse, irregular, large grains of illite, chlorite, kaolinite and mixed-layer illite/chlorite of detrital origin at all depths. The detrital origin ofillite is implied by illite-smectite textural relations, well-ordered 2*M* polytypism, and a muscovite-like composition. K is the dominant interlayer cation in smectite at all depths, in contrast to the Na and Ca that are normally present in similar rocks.

Deeper samples associated with the décollement zone contain small (up to 100 Å thick) illite packets included within still-dominant subparallel layers of contiguous smectite. AEM analyses of these packets imply illite-like compositions. Selected area electron diffraction (SAED) patterns show that this illite is the 1*M*d polytype. Packets display step-like terminations like those seen in illite of hydrothermal origin. The data collectively demonstrate that smectite transforms progressively to illite via a dissolution-recrystallization process within a depleting matrix ofsmectite, and not by a mechanism of layer replacement. This illite seems to form at depths as shallow as 500 m and temperatures of 20 ° – 30 ° C, which is in marked contrast to the much higher temperature conditions normally assumed for this transformation. This implies that the high water/rock ratios associated with the décollement zone are significant in promoting reaction.

Key Words: Accretionary wedge • AEM analyses • Barbados • Electron diffraction • Fluid-sediment interaction • Illite • Mixed-layer • Smectite • TEM images

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